

# FACTSHEET

## *Plant Protection & Quarantine*

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## Cereal Leaf Beetle

The cereal leaf beetle, *Oulema melanopus*, is a dangerous pest of wheat, oats, and barley. Originally from Europe and Asia, the beetle was first found in the United States in southwestern Michigan in 1962. From there, it spread into neighboring States.

A large-scale eradication program conducted by the U.S. Department of Agriculture (USDA) and cooperating States in 1963–69 was unsuccessful in eliminating this pest. But researchers continued to work on developing means of control, including biological control.

### Damage

While both adults and larvae of the cereal leaf beetle feed on grain plants, most of the damage is caused by the larvae, which feed on the upper leaf surface. They consume the chlorophyll-containing mesophyll cells, leaving the translucent lower leaf cuticle intact. An average of one larva per flag leaf will cause a five- to six-bushel loss of grain per acre. Adults feed by chewing completely through the leaves, creating narrow slits.

In the absence of natural enemies, this pest causes considerable damage to small-grain crops. Yield losses as high as 55 percent in spring wheat and 23 percent in winter wheat are reported in heavily infested fields, which have a frosted, withered appearance. In oats and barley, crop yields have been reduced by as much as 75 percent.

### Description and Life Cycle

The adult cereal leaf beetle is about 3/16 inch long with metallic bluish-black head and wing covers. The front of the thorax is dark red. Adults of the cereal leaf beetle first appear out of hibernation when the temperature exceeds 55 °F, usually in the spring. They mate, and the females lay their eggs on leaves. The eggs are less than 1/16 inch long. They are yellowish when first laid but darken before hatching.

Once the eggs hatch, the larvae feed on the leaves. The cereal leaf beetle larva, which is slightly longer than the adult, has a brownish-black head and legs; its body is yellowish. Except for the head and

legs, the larva is usually covered with fecal matter. By the end of 2 weeks, most of the larvae have pupated in the soil. The pupa, when removed from its earthen cell, is enveloped in a thin, transparent membrane. The pupa is bright yellow when first formed but changes to the bluish-black color of the adult before emerging from the soil.

New adults emerge from the pupal cells after 10 to 20 days. During the next 10 to 14 days, the adults feed on available lush grasses; timothy, quackgrass, and young corn are preferred. Adult beetles then enter aestivation until fall. The adults hibernate in stems of grain stubble, behind corn sheaths, under field trash, or in crevices until the following spring.

### History of Biological Control Effort

From 1964 to 1970, USDA's Agricultural Research Service (ARS) imported natural enemies of the cereal leaf beetle from Europe. The beetle is not a serious pest there because natural enemies keep it in check.

All of these natural enemies are parasitic Hymenoptera—distant cousins of ants, honey bees, and wasps. One species, *Anaphes flavipes*, injects its eggs into cereal leaf beetle eggs. When the parasite's eggs hatch, the young develop within the beetle's eggs, devouring them as they grow. Three other species, *Diaparsis temporalis*, *Lemophagus curtus*, and *Tetrastichus julis*, lay their eggs within the developing beetle larvae. After their eggs hatch, the parasite larvae feed within the pest's larvae, destroying them.

By the early 1970's, these four species were established in Michigan and Indiana. During that decade, large quantities of them were reared in Niles, MI, at USDA's National Biological Control Laboratory, a unit of the Animal and Plant Health Inspection Service's (APHIS) Plant Protection and Quarantine (PPQ) program. The three larval parasites were produced in field insectaries; the egg parasite was raised in the laboratory. These parasites were then released by PPQ personnel and cooperators.

As a result of this program, natural enemies were established where the cereal leaf beetle had spread. As the parasites became established, the pest populations decreased to subeconomic levels.

Expenditures for this program yielded benefits to society worth at least \$7 million per year, and the ratio of benefits to program costs was roughly 12 to 1. With cereal leaf beetle populations on the decline, USDA officials determined that the program was no longer necessary and terminated it in 1979.

## **The New Threat**

Since 1979, the cereal leaf beetle has slowly continued to expand its range to include most States east of the Mississippi River. In the mid-1980's, the beetle was found in Utah. Soon after, Montana and Idaho reported it in grainfields. States where this pest has been found as of 1995 include Alabama, Arkansas, Connecticut, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Utah, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.

Recently, damaging populations have been reported in the Southeast and some Middle Atlantic States. For example, damage in North Carolina was recently estimated at \$5 million per year. Economic damage in the expanded range is attributed to several factors, including the inability of some of the parasite species to spread with the pest, the unsuccessful adaptation of some of the parasite species to new environments, and farmers' use of different cultural practices.

Based on losses caused by this pest and the lack of natural enemies in the Western States, several State departments of agriculture asked APHIS to reactivate the cereal leaf beetle biological control project. APHIS reinitiated the project in 1993.

## **Current Biological Control Effort**

The goal of the reactivated project is to collect existing natural enemies from parts of the United States and Europe where they are present and distribute them in the States with new infestations. European source material will be released in parts of the Eastern and Southern United States with climates similar to the climates in the places of origin. This effort is designed to provide natural enemies that are well adapted to geographic differences in climate. The current project is a cooperative effort involving APHIS, ARS, USDA's Extension Service, State departments of agriculture, universities, and agricultural experiment stations.

Cooperators in North Carolina and Utah have set up field insectaries where the larval parasites will be released, increased, and later collected for redistribution. Cooperators will also locate selected fields for releasing the egg parasites reared at the

APHIS National Biological Control Laboratory.

APHIS and cooperators are conducting surveys to determine what natural enemies are present in States along the southern and western edges of this pest's current range. These surveys will make the release effort more efficient: only those species that are not already established in an area will be released there.

## **Economic Value of Biological Control**

Prior to the introduction of natural enemies in the United States, chemical insecticides were used extensively to suppress the cereal leaf beetle. In 1966, more than 1.6 million acres of small grains were sprayed with insecticides to control this pest. Fortunately, where the parasite complex is well established, this pest is controlled biologically at subeconomic levels without the use of pesticides.

Typically, the parasite complex can reduce cereal leaf beetle populations by 70 percent. After the natural enemies become established, yield losses can drop to less than 1 percent.